

Predictive Friction Factors for Frac Plug Drillouts - Permian/Appalachia

Challenge

Extended-lateral completions face tripping, weight, and torque issues, and pre-job feasibility is hard to assess. This study evaluates hydraulic completion units (HCUs), torque-and-drag software, and data-acquisition systems in Permian and Appalachia horizontals.

Solution

Post-job analysis replaces T&D model assumptions with site-specific friction factors for Permian and Appalachian wells, improving future offset well predictions.

Results

Accurate friction factors determined operation feasibility, optimized wash schedules, identified when heavier stick pipe was needed, and guided tailored torque-mitigation strategies.

When HCUs (snubbing units) are used instead of coiled tubing, they typically use 2 $\frac{3}{8}$ " or 2 $\frac{7}{8}$ " jointed tubing (stick pipe) and require a power tong to make connections. The advantages of using stick pipe include the ability to rotate the tubing string and apply higher forces moving in and out of the well. Coupled with rotation, stick pipe can also achieve higher annular velocities that improve hole cleaning.



Figure 1: Hydraulic Completion Units (HCUs)

As the friction factor (FF) is the largest uncertainty when running predictive T&D models for a well, establishing a friction factor from post job analysis from offset wells can greatly increase the accuracy of a model. The next page are two examples of the many post-job friction factor calibrations run for this analysis. Actual surface torque values recorded by the DAS on the HCU, which are mapped against the surface torque predicted by T&D model at a range of friction factors to establish the friction factor that was present for rotational torque both at the start of the lateral, and after torque mitigation techniques were used (washing, RPM changes, pumping viscous pills).

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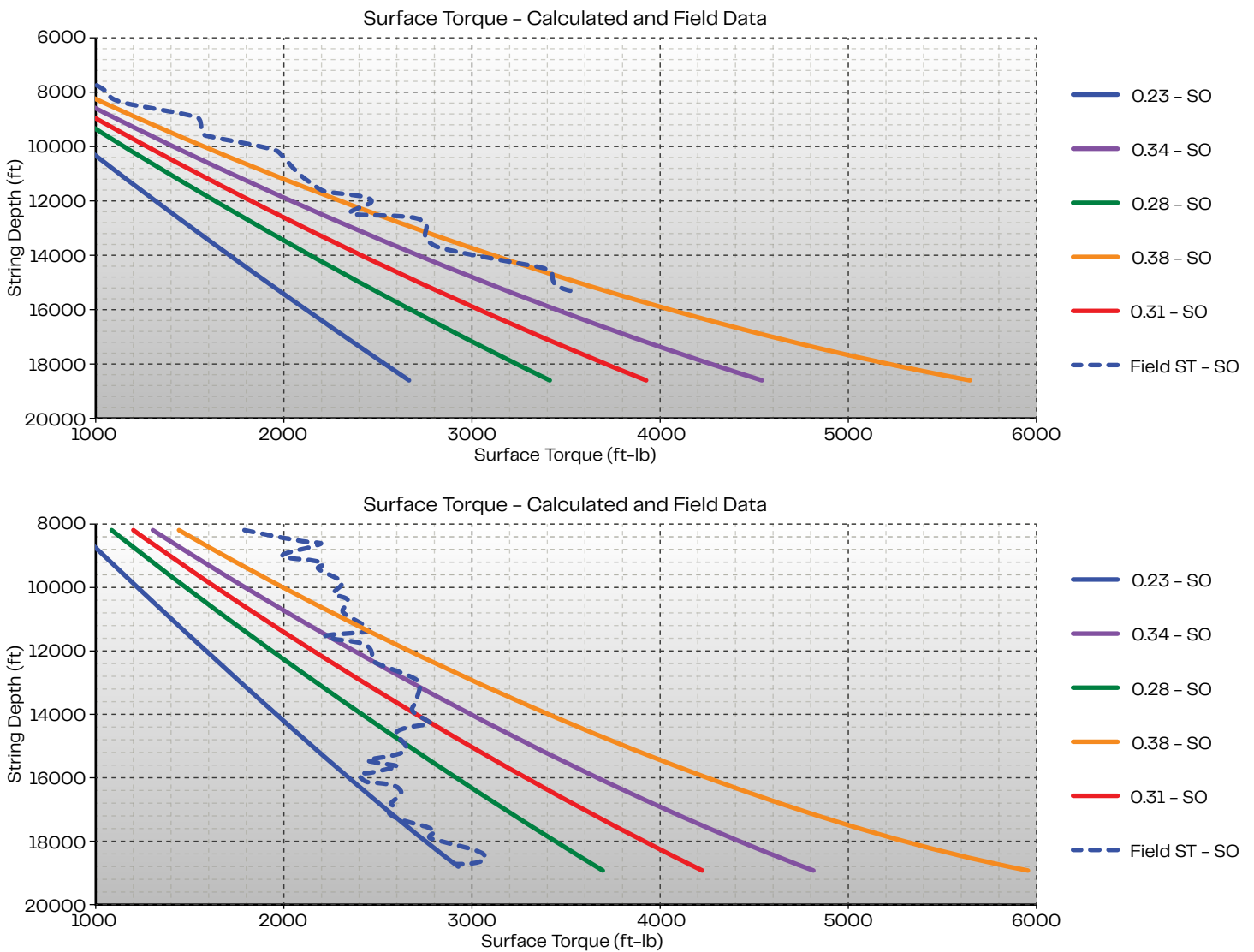


Figure 2: Friction Factor Calibration Using HCU Surface Torque Data

Predictive Friction Factors:

	Permian	Appalachia	Appalachia less A3
Lateral Entry	0.31	0.35	0.33
Operationally Adjusted	0.26	0.27	0.26

Table: Predictive Friction Factors Prior to and While Operationally Mitigating Torque

The primary use of predictive T&D results for drilling out frac plug in these wells has been identifying when larger/heavier string components might be needed for the vertical section, or lighter, thinner walled tubing needed for the lateral section. Other benefits included saved time by optimizing washing schedules and providing information precise enough to accurately identify problems and optimize solutions. Accurate T&D models also generally assist with identifying wells where the logistical, commercial, and technical trade-offs are worth embracing in an effort to mitigate torque.

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